# Bayesian network meta-analysis of face masks' impact on human physiology

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## Supplementary materials

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## Search strategy

WHO COVID DATABASE (https://search.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/):

(mask OR masks OR facemask\* OR face-mask\* OR MH:"Respiratory Protective Devices" OR N95 OR N97 OR N99 OR ffp OR ffp1 OR ffp2 OR ffp3 OR "respiratory protective supply" OR "respiratory protective equipment" OR "respiratory protective gear") AND (("tidal volume" OR "tidal volumes" OR "breathing frequency" OR "frequency of breathing" OR "respiratory rate" OR "respiratory rates" OR "partial pressure" OR "oxygen pressure" OR "heart rate" OR cardiopulmonary OR "carbon dioxide" OR saturation OR "blood pressure" ) OR ("body temperature" OR "skin temperature" OR "core temperature" OR "aural temperature" OR "exertion"))

### • MEDLINE (PUBMED, https://pubmed.ncbi.nlm.nih.gov/):

((("surgical mask"[tw] OR "cloth mask"[tw] OR "surgical masks"[tw] OR "cloth masks"[tw] OR "medical mask" [tw] OR "medical masks" OR "Respiratory Protective Devices" [MeSH Terms] OR N95[tw] OR N97[tw] OR N99[tw] OR ffp[tw] OR ffp1[tw] OR ffp2[tw] OR ffp3[tw] OR "respiratory protective equipment" [tw] OR respiratory protective gear[tw] OR face-mask\*[tw] OR face-mask\*[tw]) OR ((mask[tw] OR masks[tw]) AND ("Protective Devices" [MeSH Terms] OR "Infection control" [MeSH terms]))) AND (tidal volume\* [tw] OR breathing frequency[tw] OR frequency of breathing [tw] OR respiratory rate\* [tw] OR partial pressure [tw] OR oxygen pressure [tw] OR heart rate [tw] OR cardiopulmonary [tw] OR carbon dioxide OR saturation [tw] OR "blood pressure" [tw] OR "body temperature" [tw] OR "skin temperature" [tw] OR "core temperature" OR "aural temperature" OR "exertion")) NOT (CPAP[tw] OR "positive airway pressure" [tw] OR "laryngeal mask\*" [tw] OR anaesthesia OR postoperative [tw] OR "Perioperative Period" [MeSH Terms] OR "noninvasive ventilation" OR "non-invasive ventilation" OR "mask ventilation" OR preoxygenation OR preoxygenation OR preoxygenation OR "Respiratory Therapy" [MeSH Terms] OR (animal [tw] NOT (animal [tw] AND human [tw])))

### • CINAHL (EBSCOhost, <a href="https://search.ebscohost.com/">https://search.ebscohost.com/</a>):

((("surgical mask" OR "cloth mask" OR "surgical masks" OR "cloth masks" OR "medical mask" OR "medical masks"

OR (MH "Respiratory Protective Devices+") OR N95 OR N97 OR N99 OR ffp OR ffp1 OR ffp2 OR ffp3 OR "respiratory protective equipment" OR "respiratory protective gear" OR facemask\* OR facemask\*) OR ((mask OR masks) AND ((MH "Protective Devices+") OR (MH "Infection control+")))) AND ("tidal volume\*" OR "breathing frequency" OR "frequency of breathing" OR "respiratory rate\*" OR "partial pressure" OR "oxygen pressure" OR "heart rate" OR cardiopulmonary OR "carbon dioxide" OR "blood pressure"

OR saturation OR "body temperature" OR "skin temperature" OR "core temperature" OR "aural temperature" OR "exertion")) NOT (CPAP OR "positive airway pressure" OR "laryngeal mask\*" OR anaesthesia

OR postoperative OR (MH "Perioperative Period+") OR "noninvasive ventilation"

OR "non-invasive ventilation"

OR "mask ventilation"

OR preoxygenation

OR pre-oxygenation

OR (MH "Respiratory Therapy+") OR (animal NOT (animal AND human)))

- CENTRAL (https://www.cochranelibrary.com/central/):
- ID Search
- "surgical mask" OR "cloth mask" OR "surgical masks" OR "cloth masks" OR "medical mask" OR "medical masks" OR "N95" OR "N97" OR "N99" OR ffp OR ffp1 OR ffp2 OR ffp3 OR "respiratory protective equipment" OR "respiratory protective gear" OR face-mask\*
- #2 MeSH descriptor: [Protective Devices] explode all trees
- #3 MeSH descriptor: [Infection Control] explode all trees
- #4 (mask OR masks) AND (#2 OR #3)
- #5 #1 OR #4
- "tidal volume\*" OR "breathing frequency" OR "frequency of breathing" OR "respiratory rate\*" OR "partial pressure" OR "oxygen pressure" OR "heart rate" OR cardiopulmonary OR "carbon dioxide" OR "blood pressure" OR saturation OR "body temperature" OR "skin temperature" OR "core temperature" OR "aural temperature" OR "exertion"
- #7 #5 AND #6
- #8 MeSH descriptor: [Perioperative Care] explode all trees
- #9 CPAP OR "positive airway pressure" OR "laryngeal mask\*" OR anaesthesia

OR postoperative OR "noninvasive ventilation"

OR "non-invasive ventilation"

OR "mask ventilation"

OR preoxygenation

OR pre-oxygenation

#10 (animal NOT (animal AND human))

#11 #7 NOT (#8 OR #9 OR #10)

• Embase (https://www.embase.com/):

((("surgical mask":ti,ab,de,tn OR "cloth mask":ti,ab,de,tn OR "surgical masks":ti,ab,de,tn OR "cloth masks":ti,ab,de,tn OR "medical masks":ti,ab,de,tn OR "medical masks"

OR 'Respiratory Protective Devices'/exp OR N95 OR N97 OR N99 OR ffp:ti,ab,de,tn OR ffp1:ti,ab,de,tn OR ffp2:ti,ab,de,tn OR ffp3:ti,ab,de,tn OR "respiratory protective equipment":ti,ab,de,tn OR "respiratory protective gear":ti,ab,de,tn OR facemask\*:ti,ab,de,tn OR face-mask\*:ti,ab,de,tn OR ((mask:ti,ab,de,tn OR masks:ti,ab,de,tn) AND ('Protective Devices'/exp OR 'Infection control'/exp))) AND ("tidal volume\*":ti,ab,de,tn OR "breathing frequency":ti,ab,de,tn OR "frequency of breathing":ti,ab,de,tn OR "respiratory rate\*":ti,ab,de,tn OR "partial"

pressure":ti,ab,de,tn OR "oxygen pressure":ti,ab,de,tn OR "heart rate":ti,ab,de,tn OR cardiopulmonary:ti,ab,de,tn OR "carbon dioxide"

OR saturation:ti,ab,de,tn OR "blood pressure":ti,ab,de,tn OR "body temperature":ti,ab,de,tn OR "skin temperature":ti,ab,de,tn OR "core temperature"

OR "aural temperature"

OR exertion

)) NOT (CPAP:ti,ab,de,tn OR "positive airway pressure":ti,ab,de,tn OR "laryngeal mask\*":ti,ab,de,tn OR anaesthesia

OR postoperative:ti,ab,de,tn OR 'Perioperative Period'/exp OR "noninvasive ventilation"

OR "non-invasive ventilation"

OR "mask ventilation"

OR preoxygenation

OR pre-oxygenation

OR 'Respiratory Therapy'/exp OR (animal:ti,ab,de,tn NOT (animal:ti,ab,de,tn AND human:ti,ab,de,tn)))

## **TABLES**

	Carrizal et al.
Is the case definition adequate?	0
Representativeness of the cases	1
Selection of Controls	1
Definition of Controls	1
Comparability of cases and controls on the basis of the design or analysis	2
Ascertainment of exposure	1
Same method of ascertainment for cases and controls	1
Non-Response rate	1

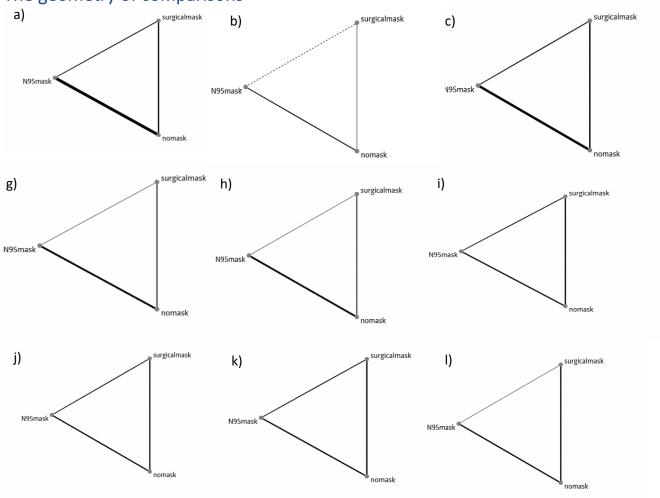
Supplementary Table 1. Risk of bias assessment of non-randomized studies

## Risk of bias assessment

		Risk of bias						
		D1	D2	D3	D4	D5	D6	Overall
	DiLeo et al. 2017	X	+	+	+	+	-	X
	Epstein et al. 2020	-	+	+	+	+	-	-
	Fikenzer et al. 2020	-	+	+	+	+	-	-
	Jones 1991	-	+	+	+	+	+	+
	Kim et al. 2013	X	+	+	+	+	-	X
	Kim et al. 2014	-	+	+	+	+	-	-
	Laird et al. 2002	X	X	+	+	+	-	X
	Li et al. 2005	-	+	+	+	+	-	-
	Luximon et al. 2016	+	+	+	+	+	-	+
φ	Mapelli et al. 2021	+	+	+	+	+	+	+
Study	Roberge et al. 2010	+	+	+	+	+	-	+
	Roberge et al. 2012a	X	+	+	+	+	-	X
	Roberge et al. 2012b	X	+	+	+	+	-	X
	Roberge et al. 2014	-	+	-	+	+	+	-
	Scarano et al. 2020	X	+	+	+	+	-	X
	Serin et al. 2020	-	+	+	+	+	-	-
	Shaw et al. 2020	+	+	+	+	+	+	+
	Spang and Pieper 2020	+	-	+	+	+	+	+
	Wong et al. 2020	-	+	+	+	+	+	+
	Yip et al. 2005	-	-	+	+	+	+	-
	D1: Bias arising from the randomization proces D2: Bias arising from period and carryover effects D3: Bias due to deviations from intended intervention D4: Bias due to missing outcome data D5: Bias in measurement of the outcome D6: Bias in selection of the reported result						Judgement  High  Unclear  Low	

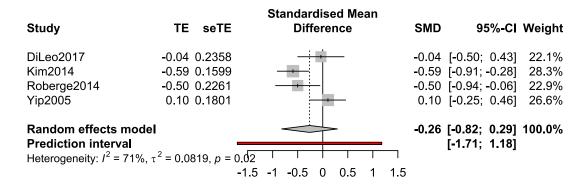
Supplementary Fig. 1 "Traffic light" plot of risk of bias assessment (based on the second version of Cochrane risk of bias tool).

## The geometry of comparisons

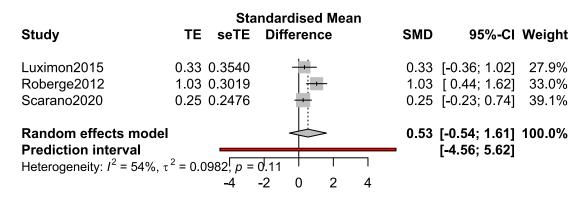


Supplementary Fig. 2. The geometry of the comparisons; a. Temperature of covered facial skin, b. RHP, c. RR, d. The temperature of facial skin not covered by a mask, e. Aural temperature, f. HR, g. SpO2, h. tcPCO2, i. HR during high-intensity exercise, j. HR during moderate-intensity exercise, k. SBP, l. RPE

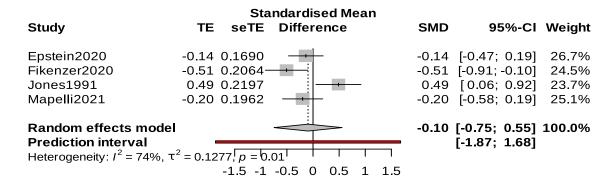
#### a) Aural temperature, N95 FFR



b) Covered facial skin temperature, surgical mask

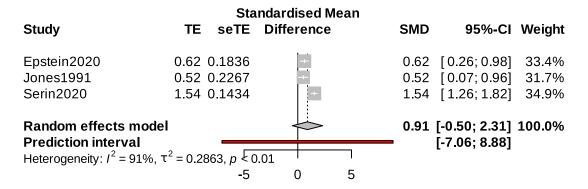


c) HR during high intensity exercise, N95 FFR

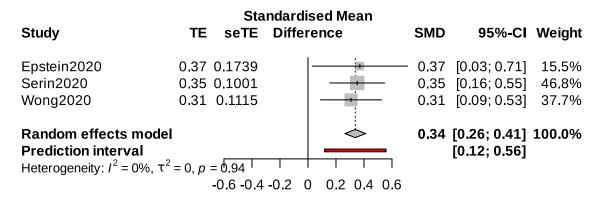


d) HR during high intensity exercise, surgical mask

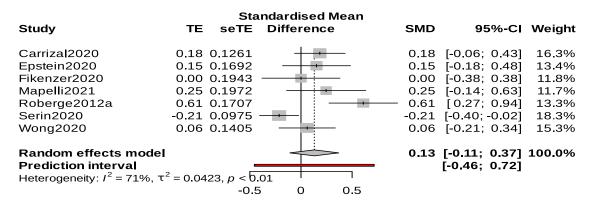
Study	Standardised Mean TE seTE Difference	SMD 95%-CI Weigh
Epstein2020	-0.33 0. <del>1729 +  </del>	-0.33 [-0.67; 0.00] 28.6%
Fikenzer2020	-0.46 <del>-0.204+</del>	-0.46 [-0.86; -0.06] 21.5%
Mapelli2021	-0.13 0.19 <del>51</del>	-0.13 [-0.52; 0.25] 23.2%
Shawn2020	0.00 0.1799	0.00 [-0.35; 0.35] 26.7%
Random effects mode		-0.22 [-0.54; 0.10] 100.0%
Prediction interval		[-0.76; 0.31]
Heterogeneity: $I^2 = 14\%$ ,	$z^2 = 0.0056, p = 0.32$	. , .
,	-0.5 0 0.5	



f) HR during moderate intensity exercise, surgical mask



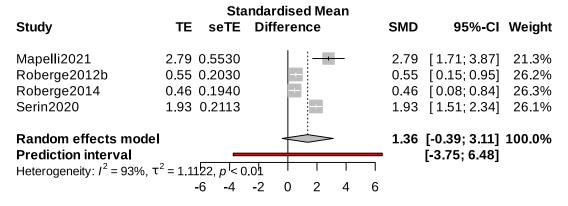
g) HR, surgical mask



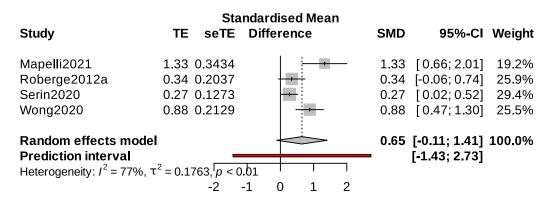
h) RHP, surgical mask

Standardised Mean								
Study	TE se	TE Differ	ence	SMD	95%-CI	Weight		
Fikenzer2020	1.14 0.44		9	1.14	[ 0.27; 2.01]	34.7%		
Luximon2015	2.75 0.82	281	-	2.75	[ 1.13; 4.38]	26.6%		
Roberge2012	0.10 0.17			0.10	[-0.24; 0.44]	38.7%		
Random effects mode Prediction interval	ı _	<	<u>-</u>	1.17	[ -2.04; 4.37] [-16.60; 18.94]	100.0%		
Heterogeneity: $I^2 = 85\%$ ,	-2 - 1 1015	n L 0 d1		<u> </u>	[-10.00, 10.94]			
rieterogeneity. 7 – 65%,		-10 -5 0	5 10	15				

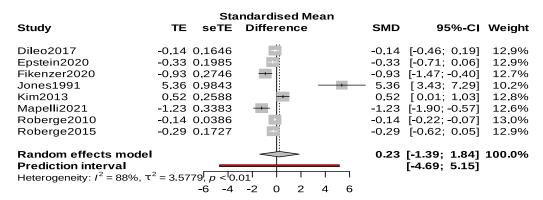
#### i) RPE, N95 FFR



j) RPE, surgical mask



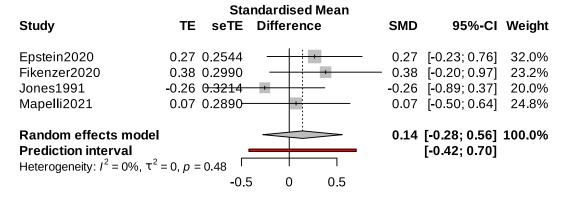
k) RR, N95 FFR



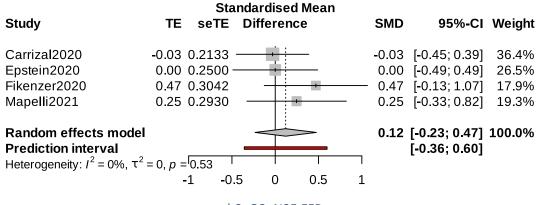
I)RR, surgical mask

Standardised Mean							
Study	TE seTE	Difference	SMD	95%-CI	Weight		
F	0.40.0.4007	2	0.40	[0.07, 0.54]	00.40/		
Epstein2020	0.12 0.1987	-		[-0.27; 0.51]	26.1%		
Fikenzer2020	-0.16 0.2306	-	-0.16	[-0.61; 0.30]	25.2%		
Mapelli2021	-1.05 0.3173 <del>-</del>	-	-1.05	[-1.67; -0.43]	22.6%		
Roberge2012a	0.49 0.1974	<del></del>	0.49	[0.11; 0.88]	26.1%		
Random effects mod	el		-0.12	[-1.14; 0.90]	100.0%		
<b>Prediction interval</b>			_	[-3.02; 2.79]			
Heterogeneity: $I^2 = 83\%$ ,	$\tau^2 = 0.3535, p^{\dagger} < 0.$	.01 10					
	-3 -2	-1 0 1 2	3				

#### m) SBP, N95 FFR



n) SBP, surgical mask



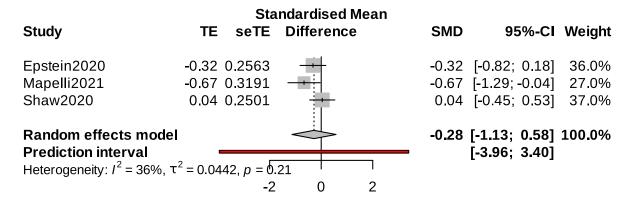
o) SpO2, N95 FFR

	Standardised Mea	n
Study	TE seTE Difference	SMD 95%-CI Weight
Enetain 2020	0.21 0.2529	0.21 [0.71, 0.20] 10.00/
Epstein2020	-0.21 <del>0.2528 • • • • • • • • • • • • • • • • • • •</del>	-0.21 [-0.71; 0.28] 18.9%
Kim2013	-0.17 0.2 <del>251                                   </del>	-0.17 [-0.61; 0.28] 23.9%
Mapelli2021	-0.28 <del>-0.2548                                      </del>	-0.28 [-0.78; 0.22] 18.6%
Roberge2010	-0.13 <del>0.3176</del>	0.13 [-0.76; 0.49] 12.0%
Roberge2015	0.09 0.2136	- 0.09 [-0.33; 0.51] 26.5%
	<b>!</b>	
Random effects mode		-0.12 [-0.31; 0.06] 100.0%
Prediction interval	<del></del>	[-0.34; 0.09]
Heterogeneity: $I^2 = 0\%$ , $\tau$	$^{2}$ = 0, $p$ = 0.83	
	-0.6-0.4-0.2 0 0.2 0.4	1 0.6

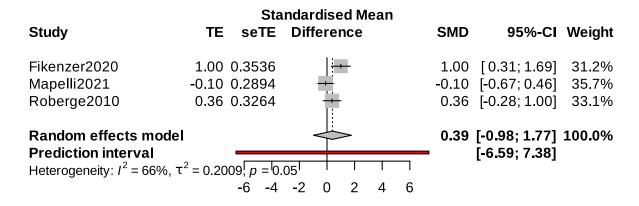
p) Uncovered facial skin temperature, N95 FFR

Study	TE seTE	Standardised Mean Difference	SMD	95%-CI Weight
Laird2002 Luximon2005 Roberge2011	0.23 0.2342 0.05 0.2533 0.10 0.1795		0.05	[-0.23; 0.69] 28.1% [-0.45; 0.55] 24.0% [-0.25; 0.45] 47.9%
Random effects m Prediction interval Heterogeneity: $I^2 = 0^{\circ}$		-0.6-0.4-0.2 0 0.2 0.4 0.6		[-0.09; 0.33] 100.0% [-0.49; 0.74]

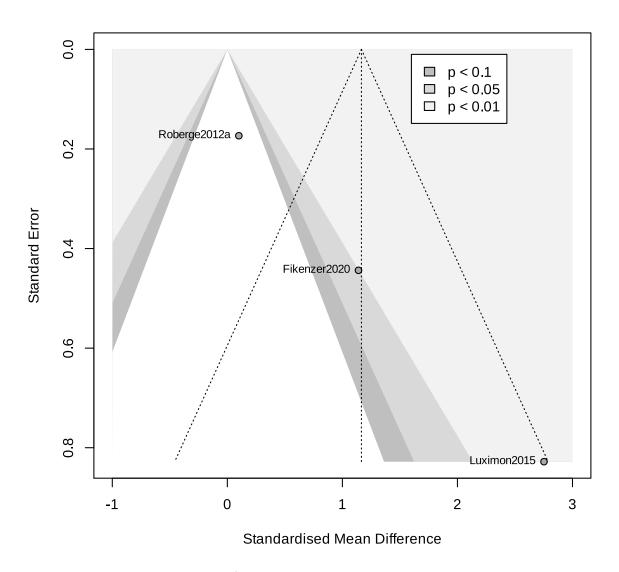
r) SpO22 during high intensity conditio, surgical mask



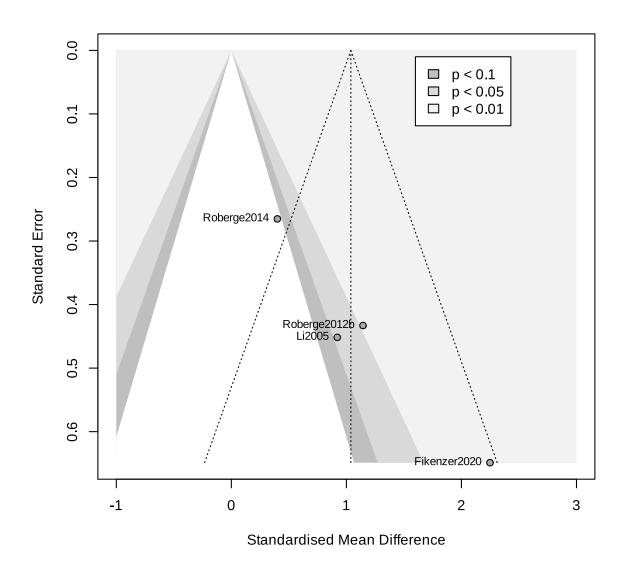
s) tidal volume, N95 FFR



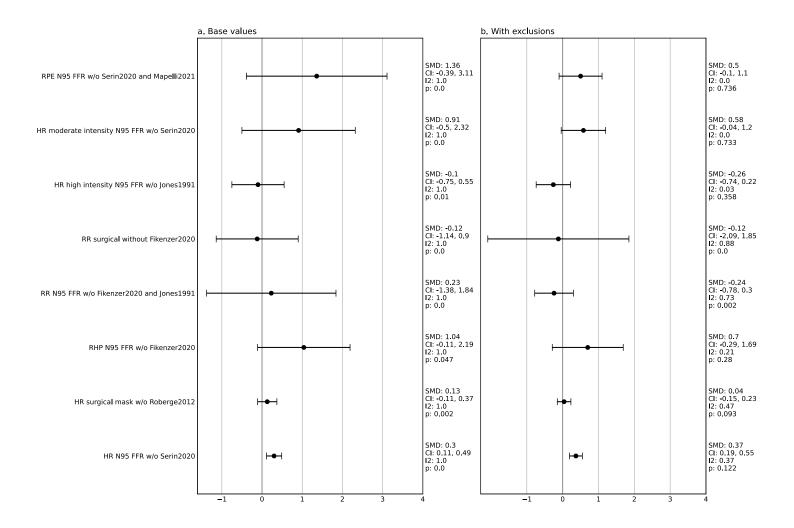
Supplementary Fig. 3. Non-significant pairwise comparison



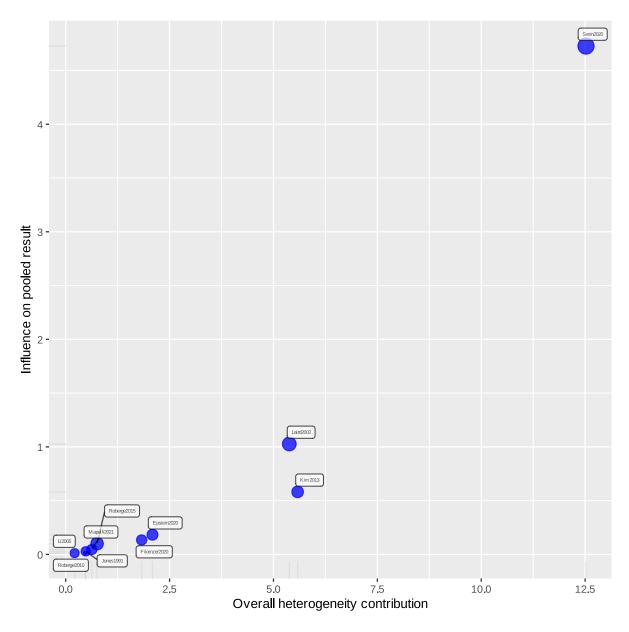
Supplementary Fig. 4. Funnel plot for pairwise comparison on RHP, surgical mask



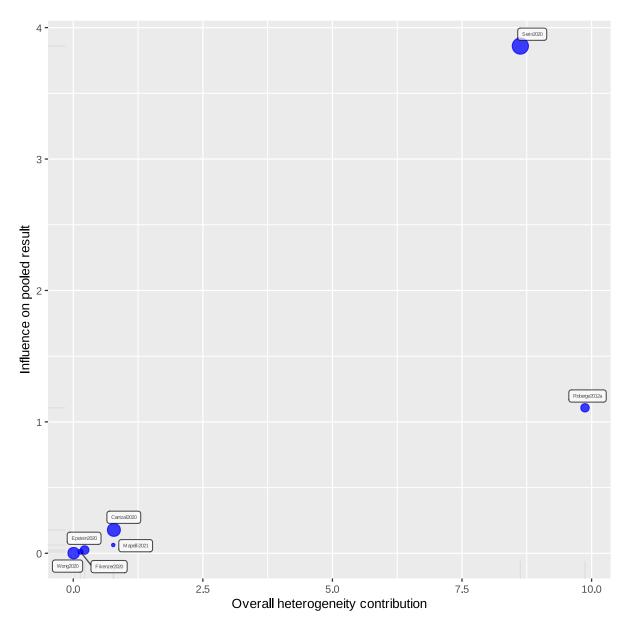
Supplementary Fig. 5. Funnel plot for pairwise comparison on RHP, N95 mask



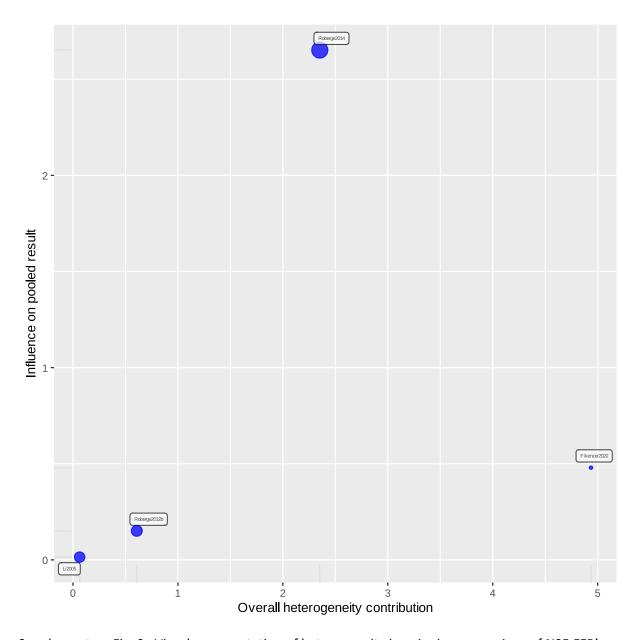
Supplementary Fig. 6. Sensitivity analysis with exclusion of studies overly contributing to heterogeneity; p - p-value for test of heterogeneity, I2 - Higgins and Thompson  $I^2$  statistic



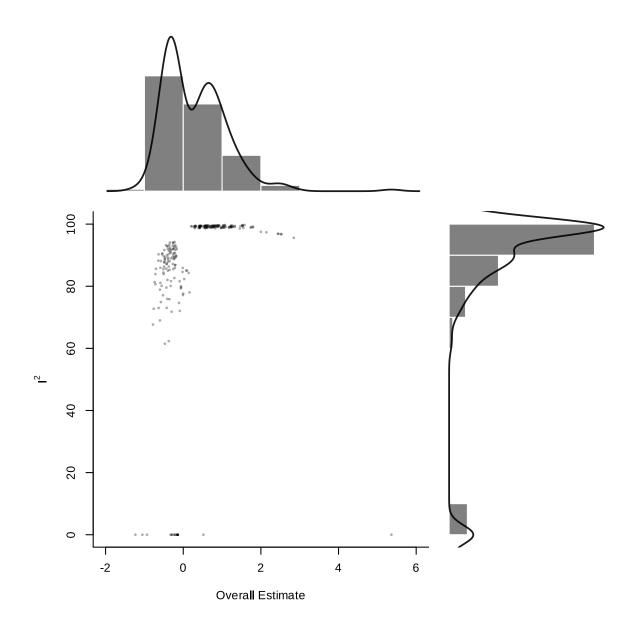
Supplementary Fig. 7. Visual representation of heterogeneity in pairwise comparison of N95 FFR's effect on heart rate.



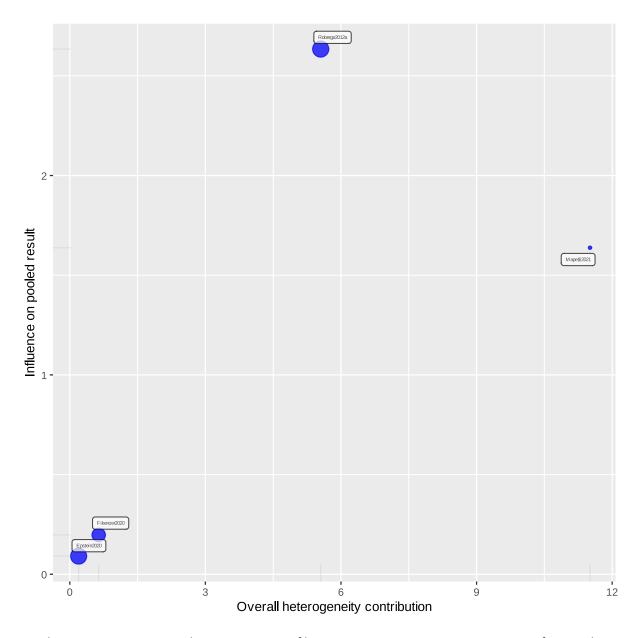
Supplementary Fig. 8. Visual representation of heterogeneity in pairwise comparison of surgical mask's effect on heart rate.



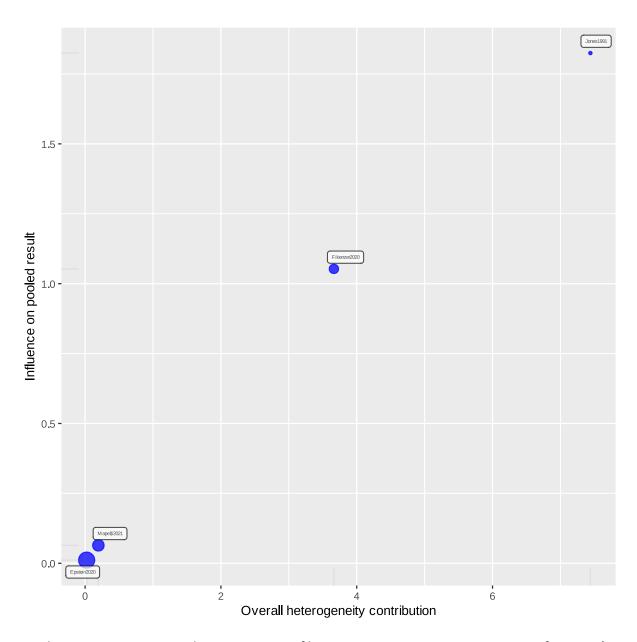
Supplementary Fig. 9. Visual representation of heterogeneity in pairwise comparison of N95 FFR's effect on rating of heat perception.



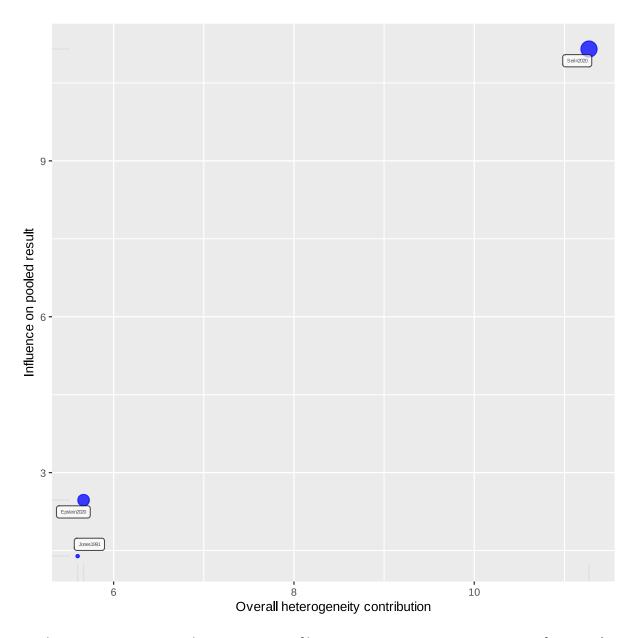
Supplementary Fig. 10. GOSH plot of N95 FFR's effect on respiratory rate. Clustering algorithms revealed that study by Fikenzer et al. (2020) and Jones et al. (1991) was overly contributing to heterogeneity.



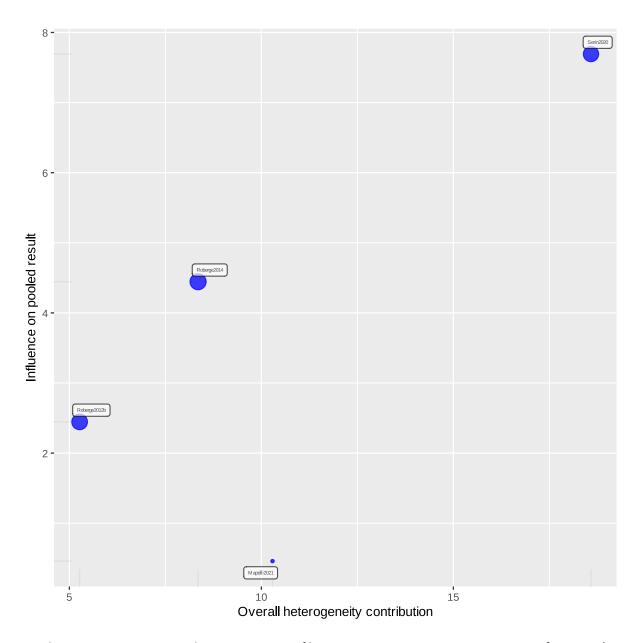
Supplementary Fig. 11. Visual representation of heterogeneity in pairwise comparison of surgical mask's effect on respiratory rate.



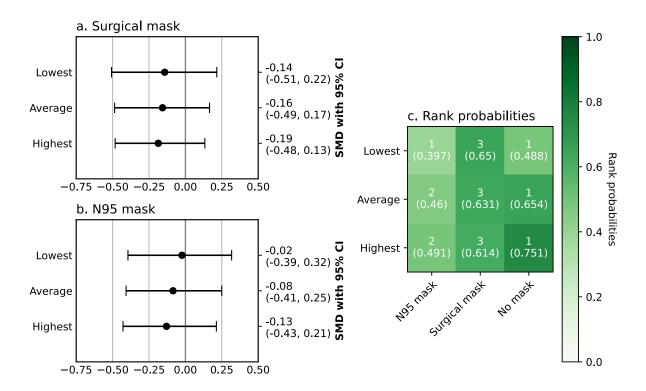
Supplementary Fig. 12. Visual representation of heterogeneity in pairwise comparison of N95 FFR's effect on heart rate during high intensity activity.



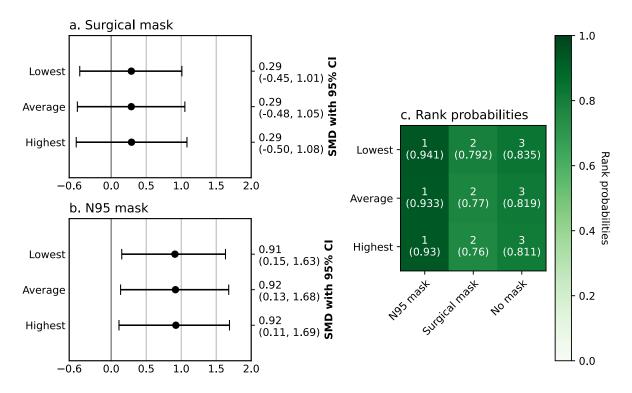
Supplementary Fig. 13. Visual representation of heterogeneity in pairwise comparison of N95 FFR's effect on heart rate during moderate intensity activity.



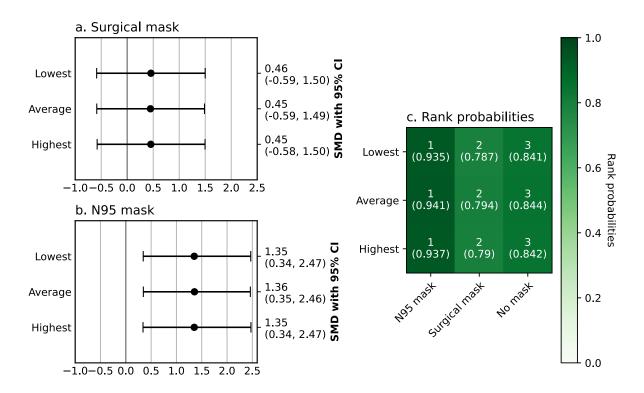
Supplementary Fig. 14. Visual representation of heterogeneity in pairwise comparison of N95 FFR's effect on rating of perceived exertion



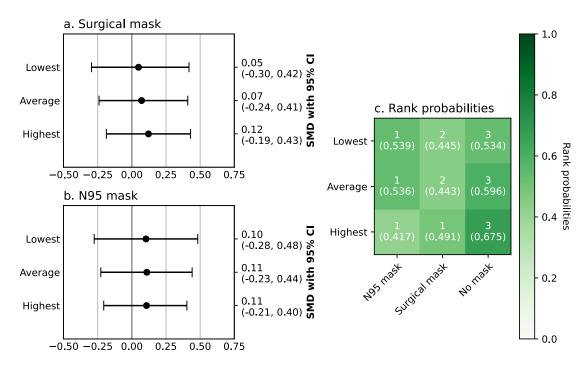
Supplementary Fig. 15. Sensitivity analysis of various imputed correlation coefficients for HR during high-intensity exercise. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



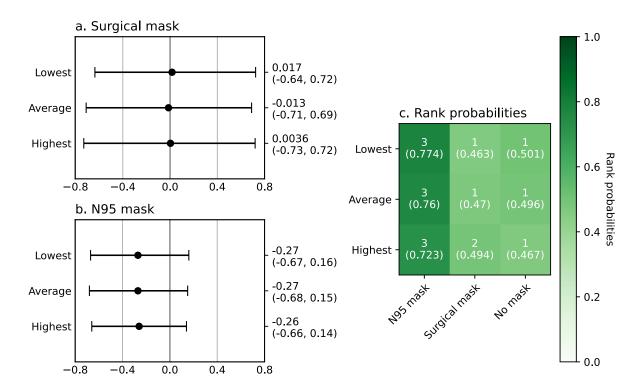
Supplementary Fig. 16. Sensitivity analysis of various imputed correlation coefficients for HR during moderate-intensity exercise. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



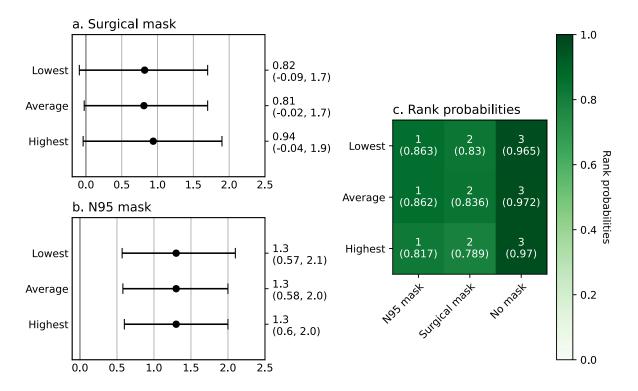
Supplementary Fig. 17. Sensitivity analysis of various imputed correlation coefficients for RPE. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



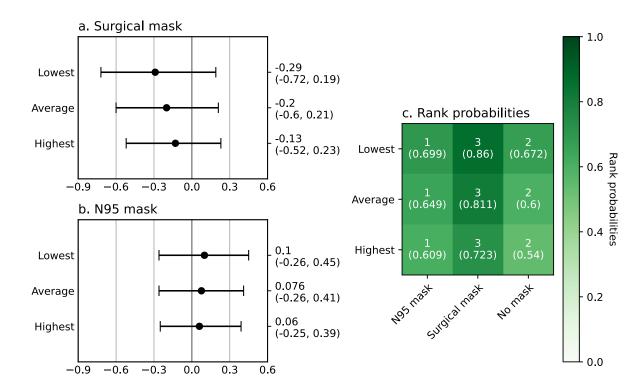
Supplementary Fig. 18. Sensitivity analysis of various imputed correlation coefficients for SBP. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



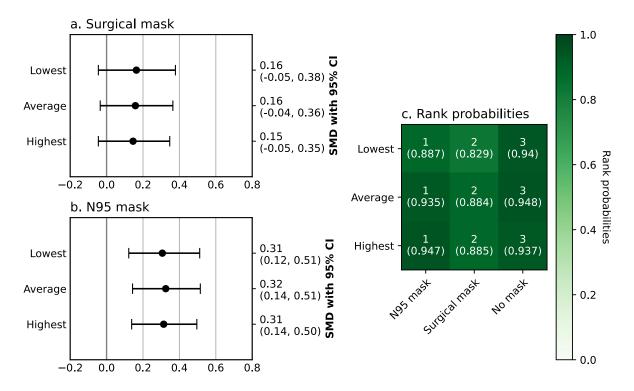
Supplementary Fig. 19. Sensitivity analysis of various imputed correlation coefficients for aural temperature. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



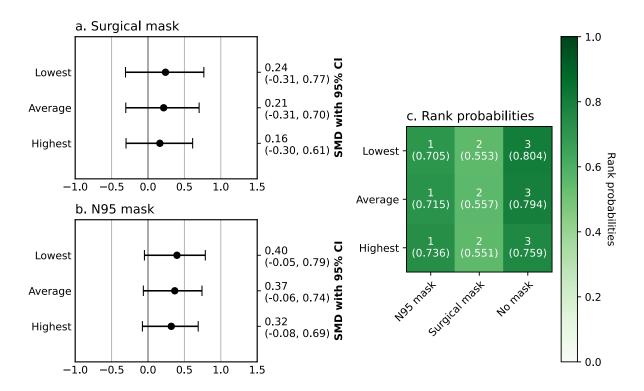
Supplementary Fig. 20. Sensitivity analysis of various imputed correlation coefficients for the temperature of facial skin covered by the mask. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



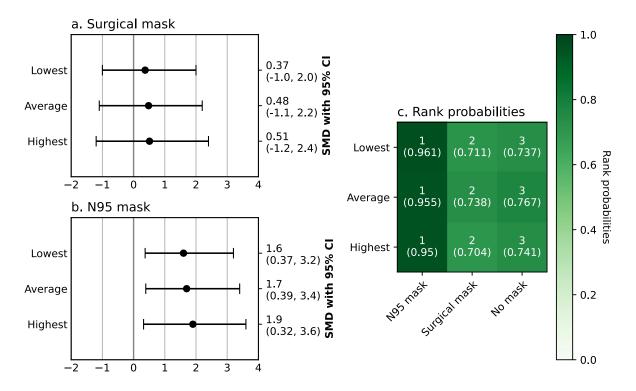
Supplementary Fig. 21. Sensitivity analysis of various imputed correlation coefficients for the temperature of uncovered facial skin temperature. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



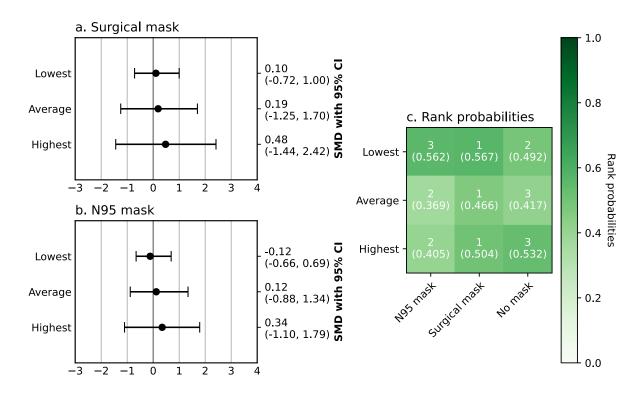
Supplementary Fig. 22. Sensitivity analysis of various imputed correlation coefficients for HR. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



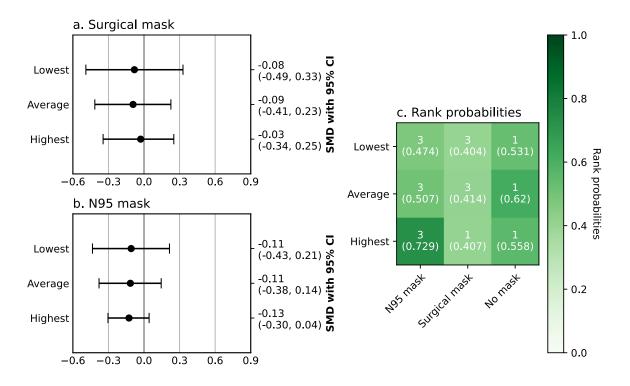
Supplementary Fig.23. Sensitivity analysis of various imputed correlation coefficients for tcPCO2. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



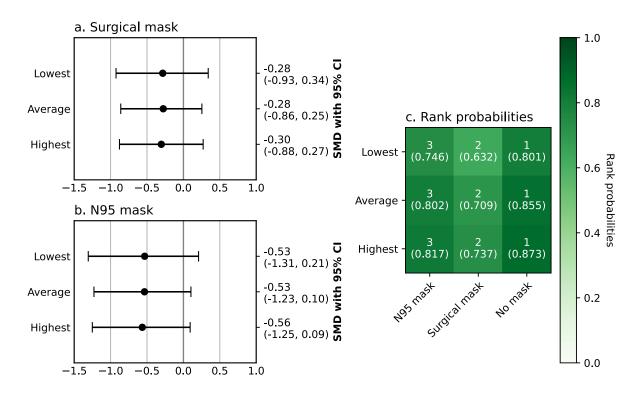
Supplementary Fig. 24. Sensitivity analysis of various imputed correlation coefficients for RHP. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



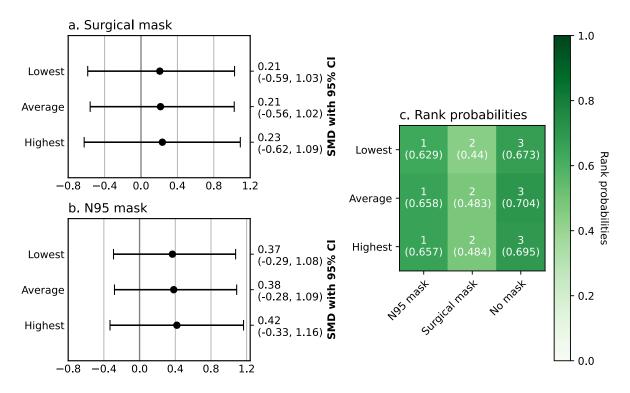
Supplementary Fig. 25. Sensitivity analysis of various imputed correlation coefficients for RR. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



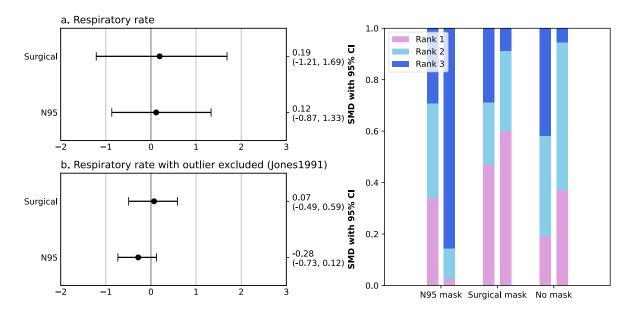
Supplementary Fig. 26. Sensitivity analysis of various imputed correlation coefficients for SpO2. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



Supplementary Fig. 27. Sensitivity analysis of various imputed correlation coefficients for spO2 during high intensity. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



Supplementary Fig. 28. Sensitivity analysis of various imputed correlation coefficients tidal volume. Numbers in rank probabilities heatmap represent rank with the highest probability and corresponding probability for given measure and condition



Supplementary Fig. 29. Sensitivity analysis of RR after exclusion of outlier study (rank probabilities on left – without exclusion; rank probabilities on rank – after exclusion)